However, let us limit ourselves to the consideration of the college education. And first, is it necessary? and if so, what should be its aims and in consequence its important features? Is a college education or an equivalent an essential part of the equipment of the electrical engineer?—we say an equivalent, for it is quite possible, though generally attended with great difficulty, for a man to follow out a course for himself by making use of spare minutes and taking advantage of every opportunity. But the instances of those that have accomplished this satisfactorily are not many.

A few years ago the answer to this question would perhaps generally have been different from what it must be to-day. We have little hesitation now in answering it in the affirmative. An adequate training in mathematics and electrical and mechanical principles must be had, however it is obtained. The college course itself is not all important, but it offers great advantages. Besides the guidance and help of the instructors, the fact of the time being carefully mapped out for employment, and the familiarity gained with the use of apparatus and machinery not often accessible elsewhere, the student has also the assistance derived from association with others and the encouragement of emulation between those working along the same lines; factors whose importance is not often overestimated. It is true that a good man, by himself, may do more than a poor man at college; but the same man will do much better with the assistance to be derived at college. A college training will not always make a good man out of a poor one, but it will make a better man out of a good one.

Of course we cannot overlook the many examples of men who have done well, and some who have met with great success, who have never entered college or taken up advanced mathematical and scientific work; but if you were to question these, you would find that most of them regret that they did not see the value of such an education sooner, or that they have not had the opportunity or time to avail themselves of it. It is a sufficient indication of its value to glance over the foremost names in the electrical field and to note the proportion of them that have received this training. That it is being appreciated is shown in the demand of the large companies for graduates of engineering schools, some admitting none but such men to the special student courses established by these works for the purpose of training men to look after the installation and running of the machinery they manufacture.

There are still some, however, who advocate the merits of the machine shop, the repair shop, the dynamo and motor room, field and armature construction and winding, the test room, etc., as an ample schooling, but the weight of opinion is now that the electrical engineer needs something more. A man who is trained only in this way, and has not obtained a pretty good working acquaintance with the elementary laws of electricity and magnetism, is liable to make ridiculous if not serious mistakes, which the man properly grounded in these principles could not possibly fall into. As a case in point, it came within our notice not so long since, where three men trained in this way agreed that a certain connection of the shunt fields of an Edison dynamo was wrong, and had it changed because they had not seen it made in that way before, and although it was pointed out to them that the current had to circulate in exactly the same direction in the coils as it did with the connections with which they were satisfied.

And what are the essential elements of this college education? This brings us to another important question. It is that of—*specialist or generalist?* or, to what extent should one specialize?

Is the electrical engineer to be a mechanical engineer as well? Some have answered "yes," and others more recently have said "no," with considerable emphasis. Sir William Thomson, now Lord Kelvin, gave as his opinion that the electrical engineer should be nine-tenths mechanical and one-tenth electrical; some of the best educationists across the line would now reverse these figures. Perhaps both are extremes; at least, they appear to be so for the requirements of the average electrical engineer of the present and for some time to come. Conditions have somewhat changed since Sir Wm. Thomson gave this advice, although there are still some engineers not even one-tenth electrical. A more even division would, however, better meet the present requirements.

The man who is working along advanced lines has need for economy. The electrical field is now so wide and extending so rapidly that many may well occupy all their time on special work. Such men are able to do with only a slight acquaintance with mechanical engineering. However, the general electrical engineer is not a specialist. As the general practitioner in medicine, he must cover a wider field. In installing plants for lighting, power supply, etc., he has to do with steam engines and boilers, and all their accessories, with shafting and bearings, belting and gearing, fly wheels, driving pulleys, etc., with water turbines and their control, with the fitting and running of construction and repair shops, etc., etc. He should, therefore, be familiar with at least the mechanical principles of the construction and running of ordinary machinery, the running conditions of the steam engine and the utilization of water power. It is not necessary that he should be a practical machinist. Most engineering colleges, therefore, either combine the two courses, or else require the electrical student to cover a good deal of the work in mechanical principles. A large part, such as the mathematics and mechanics, is necessarily the same in both.

In the planning of a college course, one of the first difficulties met with is in deciding the relative importance, with regard to the time-table, of the theoretical and practical work, and this is what different colleges disagree upon most, some devoting considerable time to foundry work and pattern making, forging, machine shop work, such as vise work, turning, etc.; while others restrict the practical work to draughting, electrical testing, etc., engine and boiler testing, dynamos and motor testing, etc., which involve the application of the more difficult principles and assist to illustrate and impress them. We think it a safe rule to follow in college to sacrifice practical work to theoretical when the former involves chiefly those operations which one can pick up readily in practice, or the mere acquiring of skill in a mechanical operation. In engineering, and especially in electrical engineering, the mathematical and scientific training necessary is becoming wider and wider. Once an engineer has started out in practice he has little time and usually less inclination to go back and work up mathematics. If he has not had a good mathematical training, he finds himself unable to read and keep abreast of the greater part of the electrical literature in the periodicals. He is not *up to date* in electrical matters, probably becomes disgusted with advanced electrical work, and the plums of the profes-